Inequality, Demand Composition, and the Transmission of Monetary Policy

Lukas Boehnert ¹  Sergio de Ferra ¹  Kurt Mitman ²  Federica Romei ¹

¹University of Oxford
²IIES, Stockholm University

Konstanz Seminar on Monetary Theory and Monetary Policy, 25 May 2023
Across-countries and within-countries, inequality affects composition of demand.
Across-countries and within-countries, inequality affects composition of demand

Does it matter?
Demand composition and the transmission of monetary policy

- Document that demand composition affects transmission of monetary policy.
Demand composition and the transmission of monetary policy

- Document that demand composition affects transmission of monetary policy.
- Countries with **high** non-tradable consumption expenditure react by **less** to a monetary policy shock.
Demand composition and the transmission of monetary policy

- Document that demand composition affects transmission of monetary policy.

- Countries with high non-tradable consumption expenditure react by less to a monetary policy shock.

- Surprising results!
  - Non-tradable sector is more subject to nominal rigidity
  - Greater exposure of output to local demand when non-tradable share is high
Non-homotheticity, heterogeneity, and market incompleteness

Key model elements to explain the results:
- non-homothetic preferences
- household heterogeneity
- market incompleteness

High non-tradable share in unequal countries
- High-income, unconstrained households spend more on non-tradables, whose nominal prices are rigid
- Poor, constrained households spend on tradables, whose prices are flexible

Dampening of monetary policy transmission!
- *Indirect effect is weaker* because constrained households do not spend much on non-tradables
Empirical Findings
Data

Sample:
- 2000-2020: Euro area countries (19)

Consumption and Income:
- Household consumption and income (Eurostat, HBS, NSO)
- Income per household quintile (Eurostat)
- Classify consumption (COICOP) as non-tradable, tradable and housing
- Non-tradable expenditure share: $\omega_{NT} = \frac{e_{NT}}{e_{NT} + e_{T}}$

Inequality:
- Gini index for disposable income (HFCS, Eurostat)
- Wealth share by percentile (WID)

Monetary Policy:
- Shocks for 2000-2020 from Jarocinski & Karadi (2020)
Non-tradable Consumption across Households

![Graph showing non-tradable consumption share (%) against disposable income.]

- **Non-parametric fit**
- ** Tradable share**
Define:

* $n$ for country
* $Y_n$ dependent variable, non-tradable expenditure share
* $Gini_j$ as average 2000-2020 Gini on net income

\[ Y_n = \alpha + \beta Gini_n + \gamma' X_n + \epsilon_n \]
Define:

* \( n \) for country
* \( Y_n \) dependent variable, non-tradable expenditure share
* \( Gini_j \) as average 2000-2020 Gini on net income

\[
Y_n = \alpha + \beta Gini_n + \gamma'X_n + \epsilon_n
\]

where \( X_n \) includes:

* average 2000-2020 GDP per capita
* average 2000-2020 old-age dependency ratio
* average 2000-2020 size of government
* average 2000-2020 trade balance

Regression weighted with average 2000-2020 GDP.
More Unequal Countries Have Higher Non-tradable Shares

Introduction

Empirical Results

Model

Quantitative Model
Monetary Policy and Non-tradable Consumption

- Study the effect of monetary policy shocks using local projection
  - Control for countries’ non-tradable consumption shares

Define:
- $y$: dependent variable
- $\omega_n$: avrg. 2000-2020 non-tradable consumption share for country $n$
- $h$: for horizon in quarters
  - $h = 0, \ldots, 12$
- $p$: for the number of lags
  - $p = 3$
- $\phi_n$: country fixed effects
- $i$: as JK (2020) monetary policy shocks

IRFs are constructed from the sequence
- $\{\beta_h\}_{h=0}^{12}$
- $\{\gamma_h\}_{h=0}^{12}$ from the estimated equation

\[
y_t + h, n - y_{t-1}, n = \alpha_h + \beta_h i_t + \gamma_h (i_t^* \bar{\omega}_n) + p X_s = \Gamma_h s + y_{t-s}, n + \phi_n + u_t + h, n
\]
Monetary Policy and Non-tradable Consumption

- Study the effect of monetary policy shocks using local projection
  * Control for countries’ non-tradable consumption shares

- Define:
  * $y$ dependent variable
  * $\omega_n$ avrg. 2000-2020 non-tradable consumption share for country $n$
  * $h$ for horizon in quarters $h = 0, \ldots, 12$
  * $p$ for the number of lags $p = 3$
  * $\phi_n$ country fixed effects
  * $i$ as JK (2020) monetary policy shocks

Introduction Empirical Results Model Quantitative Model
Study the effect of monetary policy shocks using local projection
- Control for countries’ non-tradable consumption shares

Define:
- $y$ dependent variable
- $\omega_n$ avrg. 2000-2020 non-tradable consumption share for country $n$
- $h$ for horizon in quarters $h = 0, \ldots, 12$
- $p$ for the number of lags $p = 3$
- $\phi_n$ country fixed effects
- $i$ as JK (2020) monetary policy shocks

IRFs are constructed from the sequence $\{\beta_j^h\}_{h=0}^{12}$ and $\{\gamma_j^h\}_{h=0}^{12}$ from the estimated equation

$$
y_{t+h,n} - y_{t-1,n} = \alpha^h + \beta^h i_t + \gamma^h (i_t \ast \bar{\omega}_n) + \sum_{s=1}^{p} \Gamma^h_s y_{t-s,n} + \phi_n + u_{t+h,n}\n$$
Monetary Policy and Non-tradable Consumption

Note: IRF to a one standard deviation contractionary Monetary Policy shock.
The Model
Environment

- Small open economy in a monetary union, $P^T_t = 1$
- Two households: (R)icardian and Hand-to-mouth (HtM)
- Two goods: Tradable ($T$) and Non-tradable ($N$)
- Perfect labor mobility across sectors
Households

▶ Non-homothetic preferences are described by Boppart (2014) indirect utility function

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{1}{\varepsilon} \left[ \left( \frac{e_{j,t}}{P_t^N} \right)^\varepsilon - 1 \right] - \frac{\nu}{\gamma} \left[ \left( \frac{P_t^T}{P_t^N} \right)^\gamma - 1 \right] \right), \]

where

* \( e_{j,t} \) is the nominal expenditure
* \( P_t^N \) is the price of Non-tradable good (Luxury good)
* \( P_t^T \) is the price of Tradable good

▶ Budget constraint:

\[ e_{j,t} = P_t^T c_{j,t}^T + P_t^N c_{j,t}^N = W_{j,t} l_{j,t} + \Pi_{j,t} \]

\[ + \mathbb{1}_R(P_t^T R_{t-1} B_{j,t} + R_{t-1}^n B_{j,t}^n) - \mathbb{1}_R(P_t^T B_{j,t+1} + B_{j,t+1}^n) \]

▶ Inelastic labor supply
Non-homotheticity and Demand for Non-tradables

\[ c_{Nj,t} = \left( 1 - \nu \varpi(P_N^t, P_T^t, e_{j,t}) \right) \frac{P_T^t c_{j,t}}{P_T^t} \]

(NT Demand)

\[ \varpi(P_N^t, P_T^t, e_{j,t}) \equiv \left( \frac{p_t^N}{e_{j,t}} \right)^\varepsilon \left( \frac{P_T^t}{P_N^t} \right)^\gamma \]

(T expenditure share wedge)
Non-homotheticity and Demand for Non-tradables

\[ c^N_{j,t} = \left( 1 - \frac{\nu \varpi(P^N_t, P^T_t, e_{j,t})}{\nu \varpi(P^N_t, P^T_t, e_{j,t})} \right) \frac{P^T_t c^T_{j,t}}{P^N_t} \]  

(NT Demand)

\[ \varpi(P^N_t, P^T_t, e_{j,t}) \equiv \left( \frac{P^N_t}{e_{j,t}} \right)^\epsilon \left( \frac{P^T_t}{P^N_t} \right)^\gamma \]  

(T expenditure share wedge)
Non-homotheticity and Demand for Non-tradables

\[ c_{j,t}^N = \frac{\left(1 - \nu \varpi(P_t^N, P_t^T, e_{j,t})\right)}{\nu \varpi(P_t^N, P_t^T, e_{j,t})} \frac{P_t^T c_{j,t}^T}{P_t^N} \]

(NT Demand)

\[ \varpi(P_t^N, P_t^T, e_{j,t}) \equiv \left(\frac{P_t^N}{e_{j,t}}\right)^\epsilon \left(\frac{P_t^T}{P_t^N}\right)^\gamma \]

(T expenditure share wedge)

\[ \rightarrow \text{If } \epsilon = \gamma = 0, \text{ then } c_{j,t}^N = (1 - \nu)/\nu \frac{P_t^T c_{j,t}^T}{P_t^N}. \]
Non-homotheticity and Demand for Non-tradables

\[ c_{j,t}^N = \left(1 - \nu \varpi(P_t^N, P_t^T, e_{j,t})\right) \frac{P_t^T c_{j,t}^T}{P_t^N} \]

(NT Demand)

\[ \varpi(P_t^N, P_t^T, e_{j,t}) \equiv \left(\frac{P_t^N}{e_{j,t}}\right)^\varepsilon \left(\frac{P_t^T}{P_t^N}\right)^\gamma \]

(T expenditure share wedge)

→ If \( \varepsilon = \gamma = 0 \), then \( c_{j,t}^N = (1 - \nu) / \nu P_t^N P_t^T c_{j,t}^T P_t^N \).

\[ \left(\frac{e_{R,t+1}}{e_{R,t}}\right)^{1-\varepsilon} = \beta R_t^n \left(\frac{P_t^N}{P_{t+1}^N}\right)^\varepsilon \]

(Euler equation)

\[ R_t^n = R_t \frac{P_{t+1}^T}{P_t^T} \]

(No arbitrage condition)
Production

- Firms compete under perfect competition

- Production function:
  \[ Y_s^t = (L_t^s)^{\alpha_s} \quad s = \{T, NT\} \]

  where
  \[ L_t^s \equiv (L_{HtM, t}^s)^{1-k} (L_{R, t}^s)^k \quad s = \{T, NT\} \]

- Profits:
  \[ P_t^s Y_t^s - W_t L_t^s \quad s = \{T, NT\} \]
Production

- Labor demand:

\[ W^R_{t} l_{R,t} = \alpha_s \kappa P^S_t Y^S_t \]
\[ W^{HtM}_{t} l_{HtM,t} = \alpha_s (1 - \kappa) P^S_t Y^S_t \]

- \( \kappa \) share of profits goes to \( R \) and \((1 - \kappa)\) to \( HtM \)

- Hence \( \kappa \) shapes income inequality since:
  
  - Ricardian household gets \( \kappa (P^T_t Y^T_t + P^N_t Y^N_t) \)
  
  - Hand-to-mouth household gets \((1 - \kappa) (P^T_t Y^T_t + P^N_t Y^N_t)\)
Monetary policy and equilibrium

- Monetary union, fixed exchange rate, \( P^T_t = 1 \)

- Non tradable and tradable good markets clear

\[
C^N_{HtM,t} + C^N_{R,t} = Y^N_t \quad C^T_{HtM,t} + C^T_{R,t} = Y^T_t - B_{R,t} + B_{R,t-1}R_{t-1}
\]

- Central bank supplies zero bonds

\[B^N_t = 0\]

- Labor market clears:

\[
L^T_{HtM,t} + L^{NT}_{HtM,r} = L^T_{HtM,t} \quad L^T_{R,t} + L^{NT}_{R,r} = L^T_{R,t}
\]
Income inequality and non tradable consumption share

We want to match:

- Fact 1: High-income households consume more non-tradable good
- Fact 2: Higher income inequality leads to high non-tradable consumption share
Income inequality and non tradable consumption share

- We want to match:
  - Fact 1: High-income households consume more non-tradable good ✓
  - Fact 2: Higher income inequality leads to high non-tradable consumption share ✓
Monetary Policy Shock

Fact 3: Countries with high non-tradable expenditure share react by less to monetary policy shocks

- We define period 1 as short run and period 2 onwards as long run.
- In period 1, $R_1$ increases (monetary policy shock)
- In period 1 price of non-tradable cannot adjust (extreme nominal rigidity)
- In period 1, unemployment in the non-tradable sector
Monetary Policy affects Hand-to-Mouth households in two ways:

- **Direct effect**: Ricardian consume less because of higher interest rate
- **Indirect effect**: Lower demand for non-tradable goods

Aggregate effect: Increasing in the non-tradable sector size
Two-sector TANK

- Monetary Policy affects Hand-to-Mouth households in two ways:
  - **Direct effect**: Ricardian consume less because of higher interest rate
  - **Indirect effect**: Lower demand for non-tradable good
  - **Aggregate effect**: Increasing in the non-tradable sector size
Two-sector TANK

Monetary Policy affects Hand-to-Mouth households in two ways:

- **Direct effect**: Ricardian consume less because of higher interest rate
- **Indirect effect**: Lower demand for non-tradable good

---

**Diagram:**

- **Monetary shock**
  - **Direct effect**:
    - Ricardian Households
  - **Indirect effect**:
    - Hand-to-Mouth Households
    - Tradables (Flexible Prices)
    - Non-tradables (Nominal Rigidities)
Monetary Policy affects Hand-to-Mouth households in two ways:

- **Direct effect:** Ricardian consume less because of higher interest rate
- **Indirect effect:** Lower demand for non-tradable good
- **Aggregate effect:** Increasing in the non-tradable sector size

![Diagram showing the relationship between monetary shocks and sectors]
Two-sector TANK with Non-homothetic Preferences

Monetary Policy changes with income inequality:

- When has the shock the minimum effect?

- All income to Hand-to-mouth

- Some debt to the Hand-to-mouth and all income to the Ricardian

Monetary shock

Direct effect

50% Hand-to-Mouth Households

50% Ricardian Households

50% Tradables (Flexible Prices)

50% Non-tradables (Nominal Rigidities)
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - When has the shock the minimum effect?

- All income to Hand-to-mouth
- Some debt to the Hand-to-mouth and all income to the Ricardian

- Hand-to-Mouth Households
- Ricardian Households
- Tradables (Flexible Prices)
- Non-tradables (Nominal Rigidities)

Monetary shock

Direct effect

- 25%
- 15%

Introduction

Empirical Results

Model

Quantitative Model

# 20
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  * When has the shock the minimum effect?

![Diagram]

1%  
Hand-to-Mouth Households  

99%  
Ricardian Households  

Monetary shock  

Direct effect  

Tradables (Flexible Prices)  

Non-tradables (Nominal Rigidities)
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - When has the shock the minimum effect?
    - All income to Hand-to-mouth

Introduction
Empirical Results
Model
Quantitative Model

99%
Hand-to-Mouth Households

1%
Ricardian Households

Tradables (Flexible Prices)

Non-tradables (Nominal Rigidities)

Monetary shock
Direct effect
Two-sector TANK with Non-homothetic Preferences

Monetary Policy changes with income inequality:

* When has the shock the minimum effect?
  + All income to Hand-to-mouth
  + Some debt to the Hand-to-mouth and all income to the Ricardian

![Diagram](image_url)
We want to match:

- Fact 3: Countries with high non-tradable consumption share react less to the monetary policy shock
Non-tradable consumption and monetary policy response

- We want to match:
  * Fact 3: Countries with high non-tradable consumption share react less to the monetary policy shock ✔
The Quantitative Model
Households

- **Relative to TANK version:**
  - No HtM/Ricardian distinction
  - Income process:
    - Permanent income differences
    - Ex-ante identical households within types, facing idiosyncratic income risk
  - Financial markets
    - Incomplete markets
    - Standard Aiyagari, all households can trade one-period, risk-free nominal bonds, subject to borrowing constraint
    - Borrowing constraint equal to a fraction of permanent income
    - Profits equal to a fraction of permanent income

- We retain non-homothetic preferences
Calibration and shock

- We compare 4 economies

<table>
<thead>
<tr>
<th></th>
<th>hom. pref</th>
<th>non-hom. pref</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 perm type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 perm types</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Income risk to match Gini on income in countries with low inequality (25th percentile of the inequality distribution)

- Add differences in permanent income to match Gini on income in high-inequality countries (75th percentile of the inequality distribution)

- The parameter of non-tradable preference to match the low inequality non-tradable consumption share

- Borrowing constraint implies 10% of borrowing constrained agents
Non-tradable consumption share

Homotheticity

Non-Homotheticity

Introduction

Empirical Results

Model

Quantitative Model

# 25
Document three empirical facts about the Eurozone:

1. Across countries and households: Non-tradable consumption increases with income
2. Across countries: Non-tradable consumption shares increase with income inequality
3. Monetary Policy: Weaker effects for economies with higher non-tradable consumption

Rationalize the empirical findings in a HANK model with non-homothetic preferences
Thank you very much!
Appendix
Data sources

- Consumption by sector per household (Eurostat, Household Budget survey, National Statistical Offices)
- Income per household quintile (Eurostat)
- Gini index for disposable income (Eurostat)
- Wealth share by percentile (WID)
- Shocks from 2000-2020 from Jarocinski & Karadi (2020)
## Classification of sectors

<table>
<thead>
<tr>
<th>Non-tradables</th>
<th>Tradable</th>
<th>Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Alcoholic beverages, tobacco and narcotics</td>
<td>Actual rentals for housing</td>
</tr>
<tr>
<td>Good and services for routine household maintenance</td>
<td>Audio-visual, photographic and information processing equipment</td>
<td>Imputed rentals for housing</td>
</tr>
<tr>
<td>Hospital services</td>
<td>Clothing and footwear</td>
<td>Maintenance and repair of the dwelling</td>
</tr>
<tr>
<td>Miscellaneous goods and services</td>
<td>Electricity, gas and other fuels</td>
<td>Water supply and miscellaneous services</td>
</tr>
<tr>
<td>Operation of personal transport equipment</td>
<td>Food and non-alcoholic beverages</td>
<td></td>
</tr>
<tr>
<td>Out-patient services</td>
<td>Furniture and furnishings, carpets and other floor coverings</td>
<td></td>
</tr>
<tr>
<td>Postal services</td>
<td>Glassware, tableware and household utensils</td>
<td></td>
</tr>
<tr>
<td>Recreational and cultural services</td>
<td>Household appliances</td>
<td></td>
</tr>
<tr>
<td>Restaurants and hotels</td>
<td>Household textiles</td>
<td></td>
</tr>
<tr>
<td>Telephone and telefax services</td>
<td>Medical products, appliances and equipment</td>
<td></td>
</tr>
<tr>
<td>Transport services</td>
<td>Newspapers, books and stationery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other major durables for recreation and culture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other recreational items and equipment, gardens and pets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Package holidays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Purchase of vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telephone and telefax equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tools and equipment for house and garden</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Non-tradable share (%)</td>
<td>Country</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Lithuania</td>
<td>35</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>Slovakia</td>
<td>38</td>
<td>Portugal</td>
</tr>
<tr>
<td>Estonia</td>
<td>38</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Latvia</td>
<td>40</td>
<td>Austria</td>
</tr>
<tr>
<td>Slovenia</td>
<td>44</td>
<td>Malta</td>
</tr>
<tr>
<td>Finland</td>
<td>45</td>
<td>Ireland</td>
</tr>
<tr>
<td>Germany</td>
<td>45</td>
<td>Greece</td>
</tr>
<tr>
<td>Belgium</td>
<td>48</td>
<td>Spain</td>
</tr>
<tr>
<td>Italy</td>
<td>48</td>
<td>Cyprus</td>
</tr>
<tr>
<td>France</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>
How does consumption change with income?
How does consumption change with income?
Inequality and the consumption basket

[Graph showing the relationship between residualized Gini of disposable income and residualized non-tradable cons. share for various countries.]

Return
Inequality and the consumption basket

![Graph showing the relationship between Gini of disposable income and non-tradable consumption share for various countries.](image-url)
Does the national consumption basket matter for Monetary Policy?
Non-tradable output response

- Left graph: Comparison of Low NT share (10th percentile) and High NT share (90th percentile) over 12 quarters.
- Right graph: Real NT output (%) over 12 quarters with two different trends.

# 10
Output response when controlling for the ZLB
Local Projection extensions

- Controlling for Gini
- Controlling for wealth inequality
- Return
GDP response when controlling for Gini

Notes: The IRF shows the response controlling for average net income inequality.
GDP response when controlling for wealth inequality

Notes: The IRF shows the response controlling for the average wealth share of the top 10 percent.